

CLAIMS:

1. An ultrasonic flowmeter to measure a flow rate of a fluid to be measured, comprising:

5 an ultrasonic transmitter for launching ultrasonic pulses of a predetermined frequency into the fluid to be measured in a fluid pipe from an ultrasonic transducer along a measuring line;

10 a flow velocity distribution measuring means for measuring flow velocity distribution of the fluid to be measured in a measurement region by receiving ultrasonic echoes reflected from the measurement region among the ultrasonic pulses incident into the fluid to be measured; and

15 a flow rate operation means for calculating a flow rate of the fluid to be measured in the measurement region based on the flow velocity distribution of said fluid to be measured,

20 wherein said flow velocity distribution measuring means comprises:

a graph output means for outputting a flow velocity distribution graph displaying the flow velocity distribution in two axes of positions in the inner diameter direction of the fluid pipe relating to the measuring line and fluid velocities corresponding to the inner diameter direction; and

25 an inner wall position calculating means for calculating the position of the inner wall with respect to the axis in the inner diameter direction by calculating its inflection point from the flow velocity distribution graph outputted by the graph output means, and

wherein said flow rate operation means measures a flow rate of the fluid to be measured by integral operation based on the inner wall position calculated by said inner wall position calculating means.

2. The ultrasonic flowmeter according to claim 1, wherein said flow velocity distribution measuring means includes a fine adjustment input data receiver which enables to finely adjust the inner wall position calculated by
5 the inner wall position calculating means by means of manual input.

3. An ultrasonic flowmeter to measure a flow rate of a fluid to be measured, comprising:

10 an ultrasonic transmitter for launching ultrasonic pulses of a predetermined frequency into the fluid to be measured in a fluid pipe from an ultrasonic transducer along a measuring line;

15 a flow velocity distribution measuring means for measuring flow velocity distribution of the fluid to be measured in a measurement region by receiving ultrasonic echoes reflected from the measurement region among the ultrasonic pulses incident into the fluid to be measured; and

a flow rate operation means for calculating a flow rate of the fluid to be measured in the measurement region based on the flow velocity distribution of said fluid to be measured,

wherein said flow velocity distribution measuring means comprises:

20 a graph output means for outputting a flow velocity distribution graph displaying the flow velocity distribution in two axes of positions in the inner diameter direction of the fluid pipe relating to the measuring line and the fluid velocity corresponding to the inner diameter direction;

25 a manual input data receiver for receiving manual input data regarding an inner wall position with respect to the axis in the inner diameter direction; and

an inner wall position calculating means for calculating the inner wall position with respect to the axis in the inner diameter direction based on the manual input data received by the manual input data receiver,

5 wherein said flow rate operation means measures a flow rate of the fluid to be measured by integral operation based on the inner wall position calculated by said inner wall position calculating means.

4. A method of flow rate measurement using an ultrasonic flowmeter measuring a flow rate of a fluid to be measured, comprising:

10 an ultrasonic transmitter for launching ultrasonic pulses of a predetermined frequency into the fluid to be measured in a fluid pipe from an ultrasonic transducer along a measuring line;

15 a flow velocity distribution measuring means for measuring flow velocity distribution of the fluid to be measured in a measurement region by receiving ultrasonic echoes reflected from the measurement region among the ultrasonic pulses incident into the fluid to be measured; and

20 a flow rate operation means for calculating a flow rate of the fluid to be measured in the measurement region based on the flow velocity distribution of said fluid to be measured, and

25 by said flow velocity distribution measuring means, the method comprising the steps of:

graph outputting to output a flow velocity distribution graph displaying the flow velocity in two axes of positions in the inner diameter direction of the fluid pipe relating to the measuring line and fluid velocities corresponding to the inner diameter direction;

inner wall position calculating to calculate the position of the inner

wall with respect to the axis in the inner diameter direction; and

flow rate operating to calculate the flow rate of the fluid to be measured by integral operation based on the inner wall position calculated at said inner wall position calculation step by said flow rate operation means.

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5. A method of flow rate measurement using an ultrasonic flowmeter to measure a flow rate of a fluid to be measured, comprising:

10 an ultrasonic transmitter for launching ultrasonic pulses of a predetermined frequency into the fluid to be measured in fluid pipe from an ultrasonic transducer along a measuring line;

a flow velocity distribution measuring means for measuring flow velocity distribution of the fluid to be measured in a measurement region by receiving ultrasonic echoes reflected from the measurement region among the ultrasonic pulses incident into the fluid to be measured; and

15 a flow rate operation means for calculating a flow rate of the fluid to be measured in the measurement region based on the flow velocity distribution of said fluid to be measured, and

by said flow velocity distribution measuring means, the method comprising the steps of:

20 graph outputting to output a flow velocity distribution graph displaying the flow velocity distribution in two axes of positions in the inner diameter direction of the fluid pipe relating to the measuring line and fluid velocities corresponding to the inner diameter direction;

25 manual input data receiving to receive manual input data regarding the inner wall position with respect to the axis in the inner diameter direction;

inner wall position calculating to calculate the inner wall position

with respect to the axis in the inner diameter direction based on the manual input data received at the manual input data receiving step; and

5 flow rate operating to calculate the flow rate of the fluid to be measured by integral operation based on the inner wall position calculated at said inner wall position calculation step by said flow rate operation means.

6. A computer program product executing to control an ultrasonic flowmeter to measure a flow rate of a fluid to be measured, comprising:

10 an ultrasonic transmitter for launching ultrasonic pulses of a predetermined frequency into the fluid to be measured in a fluid pipe from an ultrasonic transducer along a measuring line;

15 a flow velocity distribution measuring means for measuring flow velocity distribution of the fluid to be measured in a measurement region by receiving ultrasonic echoes reflected from the measurement region among the ultrasonic pulses incident into the fluid to be measured; and

a flow rate operation means for calculating a flow rate of the fluid to be measured in the measurement region based on the flow velocity distribution of said fluid to be measured,

20 wherein said computer program product makes the ultrasonic flowmeter execute the steps of:

25 graph outputting to output a flow velocity distribution graph displaying the flow velocity distribution in two axes of positions in the inner diameter direction of the fluid pipe relating to the measuring line and fluid velocities corresponding to the inner diameter direction by the flow velocity distribution measuring means;

inner wall position calculating to calculate the inner wall position

with respect to the axis in the inner diameter direction by calculating the inflection point from the fluid velocity distribution graph outputted at the graph outputting step; and

5 flow rate operating to calculate the flow rate of the fluid to be measured by integral operation based on the inner wall position calculated at the inner wall position calculation step.

7. A computer program product to control an ultrasonic flowmeter to measure a flow rate of a fluid to be measured, comprising:

10 an ultrasonic transmitter for launching ultrasonic pulses of a predetermined frequency into the fluid to be measured in a fluid pipe from an ultrasonic transducer along a measuring line;

15 a flow velocity distribution measuring means for measuring flow velocity distribution of the fluid to be measured in a measurement region by receiving ultrasonic echoes reflected from the measurement region among the ultrasonic pulses incident into the fluid to be measured; and

20 a flow rate operation means for calculating a flow rate of the fluid to be measured in the measurement region based on the flow velocity distribution of said fluid to be measured,

wherein said computer program product makes the ultrasonic flowmeter execute the steps of:

25 graph outputting to output a flow velocity distribution graph displaying the flow velocity distribution in two axes of positions in the inner diameter direction of the fluid pipe relating to the measuring line and fluid velocities corresponding to the inner diameter direction by the flow velocity distribution measuring means;

manual input data receiving to receive manual input data regarding the inner wall position with respect to the axis in the inner diameter direction;

inner wall position calculating to calculate an inner wall position with respect to the axis in the diameter direction; and

- 5 flow rate operating to calculate the flow rate of the fluid to be measured by integral operation based on the inner wall position calculated at the inner wall position calculation step.